HYDROLOGY REPORT
TPM 20778

PREPARED BY:

MAY ENGINEERING & SURVEYING, INC.
9880 NORTH MAGNOLIA AVE. #205
SANTEE, CAL. 92071
PHONE: 619-463-8580
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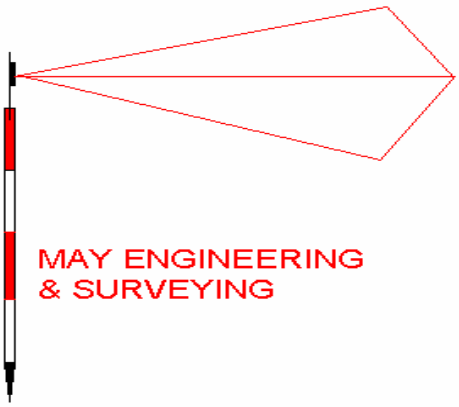
FOR: JOHN PYNENBURG
21321 BARRETT SMITH ROAD
DULZURA, CAL. 91917



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Project Discussion

Project Purpose

The purpose of the project is to subdivide a 76.3 acre parcel into 4 residential lots and a remainder lot. The project is located within the Jamul/Dulzura community plan. The land is designated as Land Use A-72 multi-rural for 4-8-20 acre lot size. This land use designation is for the purpose of large residential lots such as those proposed by the project.

The project is located along State Route 94 approximately 1.5 miles east of Barrett Lake Road. See the location maps following this page.

5638 Lake Murray Blvd. #216
La Mesa, CA 91942

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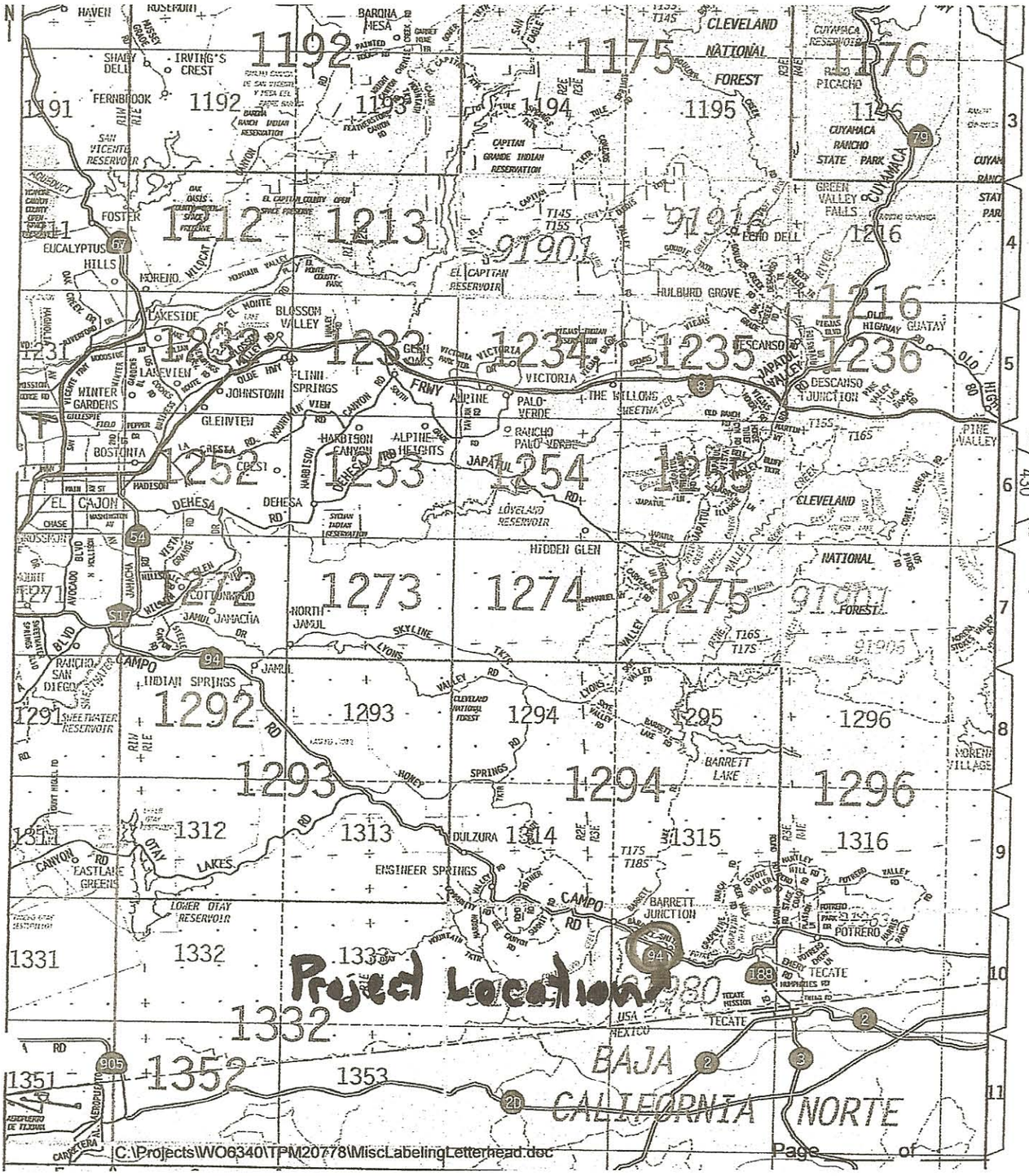
VICINITY MAP



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Aerial Photograph of Project Area

Image Date
3-2-03

1 inch equals 250 feet

Vicinity Map

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Description of Watershed

The general area is primarily undeveloped with only scattered dwelling units on large acreage lots. The immediate area is mostly undeveloped with a few developed lots such as this project (see aerial photo previous page). The elevations on the project site range from approximately 1000 feet above sea level at the northern property line to approximately 2000 feet above sea level at the southern boundary of the property.

Most of the drainage flows originate on the project or from properties immediately adjacent to the project. The drainage on the site flows generally from the south towards the north end of the property. Some small areas drain onto the property from the south and the east. The drainage from the property empties into Potrero Creek, a major watercourse that passes from east to west adjacent to the northerly boundary of the project. The largest watercourse on the project is less than 70 acres. This results in relatively small drainage areas with small flows.

Methodology

The hydrology analysis for this project was conducted in accordance with the San Diego County Hydrology Manual dated June 2003. Because of the size of the drainage basins involved, the Rational Method was used as specified on page 3-1 of the Manual. There are no junctions of independent basins as described in Section 3.4 of the Hydrology Manual. Therefore, it was not necessary to use the Modified Rational Method to combine flows.

All hydraulic analysis was conducted in accordance with standard engineering practice. The references used for these analyses include King's Handbook of Hydraulics, normographs from the Bureau of Public Roads, the City of San Diego and other commonly accepted sources.

Summary of Flows after Project

Location	Description	Area (acres)	Q (c.f.s)
1	Natural channel at the northwest corner of project.	62.4	102
2	Natural channel near north center of project.	5.4	10.5
3	Natural channel at the northeast corner of project.	11.8	20.3
4	Existing CMP under Barrett Smith Road near the west boundary of the project.	45.9	81
5	Existing 24” CMP under Barrett Smith Road near the east boundary of the project.	10.2	18.1
6	Existing 12” CMP under Barrett Smith Road near the center of the project	3.2	6.6
8	Existing 30” CMP under State Route 94 near the east boundary of the project.	6.9	16.2
9	Existing 42” CMP under State Route 94 near the east boundary of the project.	18.1	37
10	Existing 24” CMP under State Route 94 near the east boundary of the project.	8.8	18.1
11	Existing 24” CMP under State Route 94 near the east boundary of the project.	2.2	5.0

Conclusions

The project has no impact at all on most of the drainage flowing through the property. The reason for this is that there is no construction within most of the drainage basins so that the after project condition is identical with the before condition.

Concentration point 1 is the continuation of the watercourse flowing from point 10 through point 4 to point 1. At this location the watercourse empties directly into the Potrero Creek, a major watercourse. The existing Q_{100} flow rate is 101 c.f.s. and the after project flow rate is 102 c.f.s. This represents approximately a 1% increase in flow which is much smaller than the expected accuracy range of the hydrology methods used. Additionally, Potrero Creek has such a large flow rate that the entire 102 c.f.s. is insignificant; the additional 1 c.f.s. is totally inconsequential. The result will be that the project has no calculable impact at all at this point.

Concentration points 2 and 3 are also along the northern boundary of the project where the flows from the site empty into Potrero Creek. These two drainage basins have construction proposed within them. However the construction impacts such a small percentage of the drainage basin areas (less than ¾ of 1%) that the calculated post-project flows remain essentially the same as the pre-project flows.

Concentration point 4 is at an existing 24" CMP under Barrett Smith Road. Both the upstream and downstream ends of this pipe are within the project limits. The existing flow at this culvert is 80 c.f.s. and the flow after the project will be 81 c.f.s. The existing 24" culvert with a headwall has a capacity of 26 c.f.s., which is well short of the expected flow both before and after the project. The remaining 54 c.f.s. (55 c.f.s. after the project) will overflow Barrett Smith Road and come back into the watercourse immediately downstream. The difference in depth of this flow between the before and after conditions is imperceptible. The project therefore has negligible impact on this culvert since the culvert is grossly undersized for the existing flow.

Concentration point 5 is at an existing 24" CMP under Barrett Smith Road. This concentration point is downstream of concentration point 11 and like it has no construction proposed within its drainage basin. The project therefore has absolutely no impact at all on this culvert.

Concentration point 6 is at an existing 12" CMP under Barrett Smith Road. This concentration point is downstream of an existing dwelling and has no construction proposed within its drainage basin as a part of this project. The project therefore has absolutely no impact at all on this culvert.

Concentration points 8 and 9 are at existing 30" and 42" CMP culverts under State Route 94. These concentration points are to the west of all construction proposed for this project. There is no construction proposed within these drainage basins and the project therefore has absolutely no impact at all on these culverts.

Concentration point 10 is at an existing 24"CMP under State Route 94. Both the upstream and downstream ends of this pipe are within the project limits. The existing flow at this culvert is 17.3 c.f.s. and the flow after the project will be 18.1 c.f.s. The existing 24" culvert with a headwall has a capacity of 26 c.f.s., which is well in excess of the expected flow. This is in compliance with the normal design practice of Caltrans which is to design culverts based on the ultimate buildout of the drainage basin. This practice results in Caltrans normally installing culverts that able to continue to function as designed while the surrounding land is developed. The additional 0.8 c.f.s. of flow calculated to be caused by the project will only cause the inlet pond upstream of the culvert to raise 0.1' which will still be below the top of the headwall. The project therefore has negligible impact on this culvert since the culvert was probably originally designed to accommodate this type of development.

Concentration point 11 is at an existing 24" CMP culvert under State Route 94. This concentration point is upstream of concentration point 5 and to the east of all construction proposed for this project. There is no construction proposed within this drainage basin and the project therefore has absolutely no impact at all on this culvert.

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Hydrology Study

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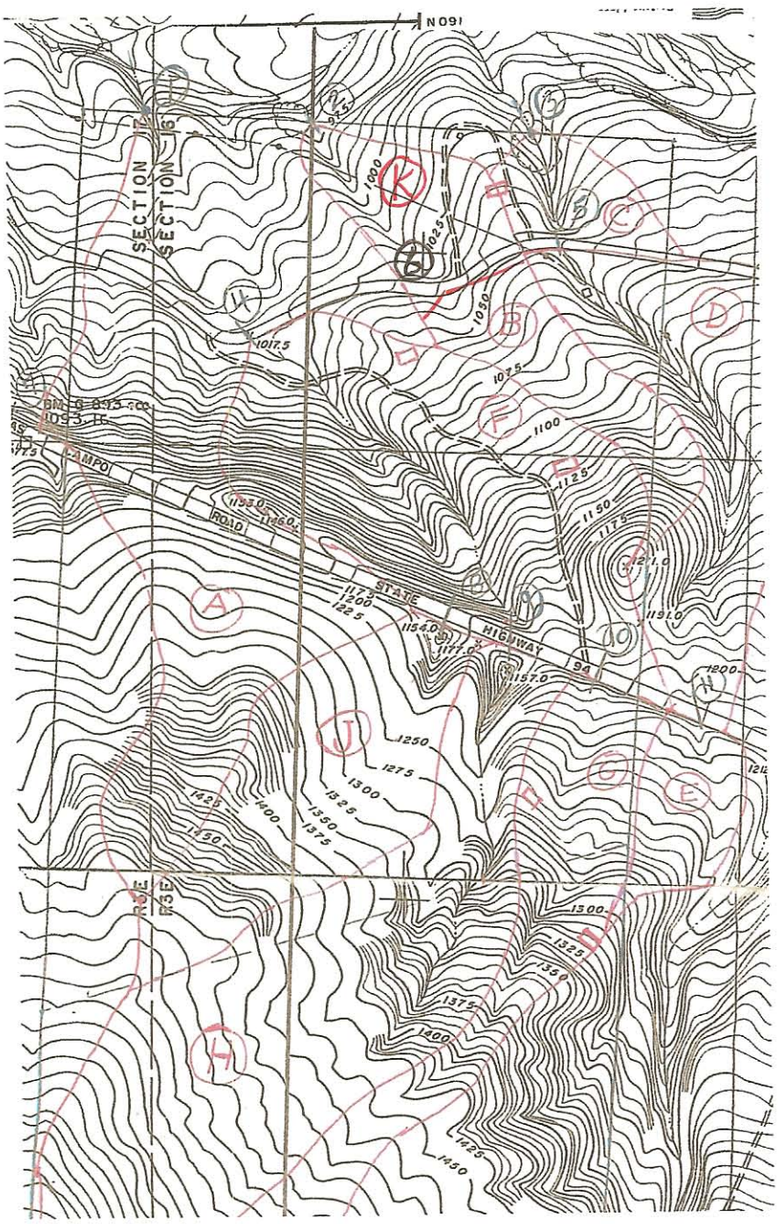
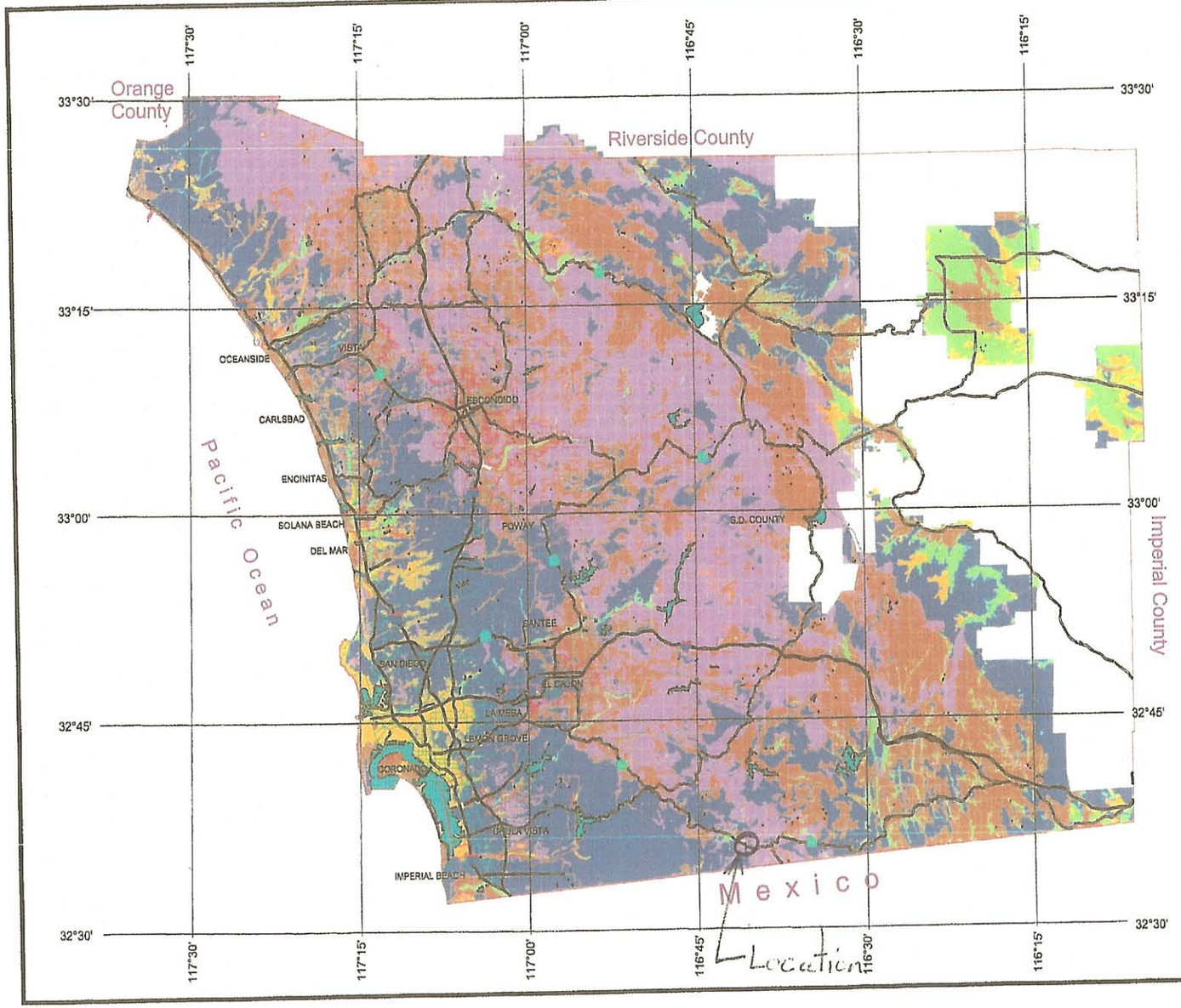


Scale 1" = 400'

Watershed Boundary/Topographic Map

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups
- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

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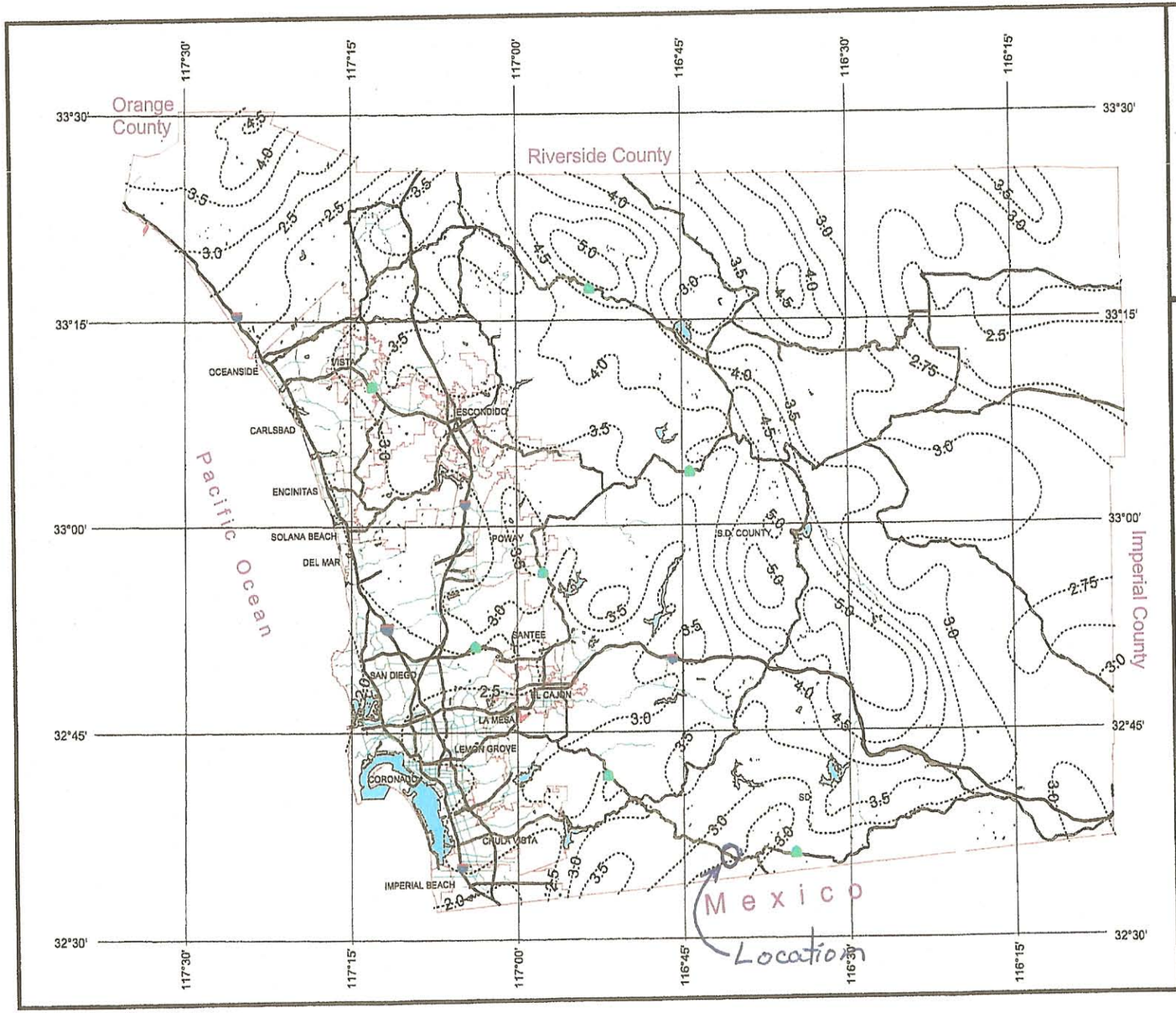
3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials



100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

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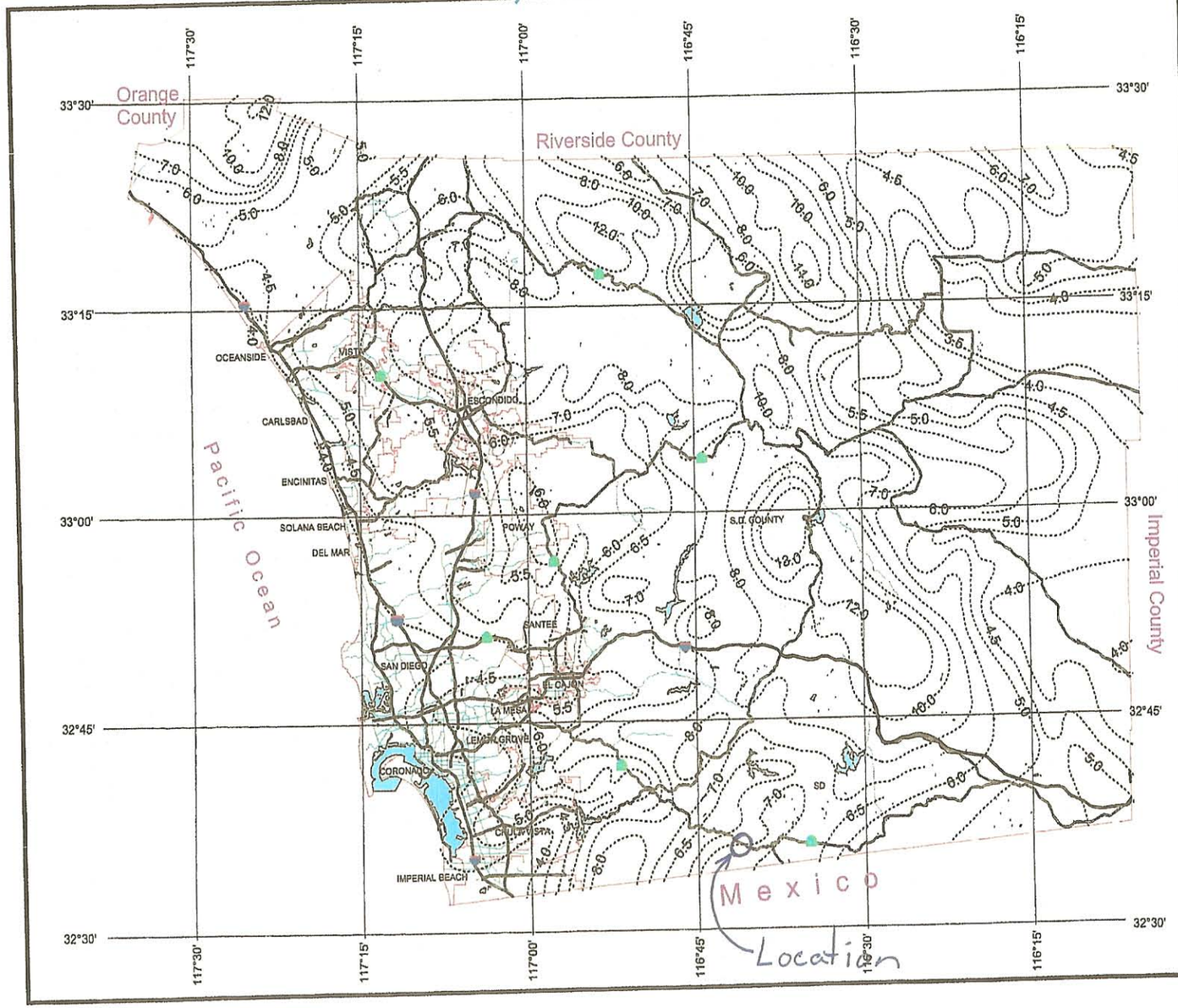
3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (Inches)



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WORK ORDER NO. 6340

HYDROLOGY / HYDRAULICS REPORT

JOB NO. TPM 20778

OWNER: John Pynenburg

DECLARATION OF RESPONSIBLE CHARGE

I hereby declare that I am the engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in section 6703 of the Business and Professions Code, and the design is consistent with current standards.

I understand the check of the project drawings and specifications by the County of San Diego is confined to review and does not relieve me of responsibilities for project design.

May Engineering & Surveying
9880 North Magnolia Ave. #205
Santee, CA 92071

_____ _____

Elliott M. May R.C.E. 18592 Date
My registration expires 6-30-2005

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Hydrology Study

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Area Calculations

Point #	Basin #	Area (sq.in.)	Area (acres)	Hi pt	Low pt	Elev change	Basin Length	Basin slope (%)
1	A, F, G,H, J	67.9	62.4	2125	950	1175	3800	30.9%
2	B,K	5.9	5.4	1211	970	241	1500	16.1%
3	C, D, E	12.9	11.8	1310	1010	300	2000	15.0%
4	F, G, H, J	50	45.9	2125	1017	1108	3200	34.6%
5	D, E	11.1	10.2	1310	1055	255	1800	14.2%
6	B	3.5	3.2	1211	1037	174	1100	15.8%
8	J	7.5	6.9	1535	1154	381	1100	34.6%
9	H	19.7	18.1	2125	1157	968	2200	44.0%
10	G	9.6	8.8	2100	1195	905	2200	41.1%
11	E	2.4	2.2	1310	1210	100	600	16.7%

Hydrology Analysis
Before Conditions

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Hydrology Calculations

Hydrology Analysis of area(s) = **A, F, G, H, J**
Concentration Point = **1**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	62.4			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	62.4	0.30	18.72	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	18.72	

Calculate Tc
This basin is downstream of concentration point 4 (basins F,G,H and J)
Concentration point 4 has the longest Tc of 10.5 minutes

Ti =	10.5	min.

Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 50 cfs (1/2 expected flow) for travel time calculation.

Q=	50	c.f.s.
BW =	2	feet
Z =	3:01	
s =	8%	
n =	0.040	
Depth =	1.14	feet
Velocity =	8	f.p.s.
Basin Length =	1000	feet
less Ti distance =	0	feet
Tt distance =	640	feet
Tt distance/Velocity =	80	seconds
=	1.3	minutes
Tc = Ti + Tt =	11.8	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	5.37	inch/hr
Q=∑(CA) * I	**101**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **B,K**
Concentration Point = **2**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	5.4			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	5.4	0.30	1.62	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	1.62	

Calculate Tc

Approximate slope for the first 100' of the basin= 21.00 %
D = distance over which Ti develops = 100 feet (Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33 From Figure 3-3)
Ti = 5.2 min.
Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 5 cfs (1/2 expected flow) for travel time calculation.

Q=	5	c.f.s.
BW =	2	feet
Z =	3:01	
s =	16%	
n =	0.040	
Depth =	0.34	feet
Velocity =	6.2	f.p.s.
Basin Length =	1500	feet
less Ti distance =	100	feet
Tt distance =	1400	feet
Tt distance/Velocity =	226	seconds
=	3.8	minutes
Tc = Ti + Tt =	9.0	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	6.42	inch/hr
Q=∑(CA) * I	**10.4**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **C, D, E**
Concentration Point = **3**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	11.8			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	11.8	0.30	3.54	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	3.54	

Calculate Tc
This basin is downstream of concentration point 5 (basins D and E)
Concentration point 5 has the Tc of 10.2 minutes

Ti =	10.2	min.

Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 10 cfs (1/2 expected flow) for travel time calculation.

Q=	10	c.f.s.
BW =	2	feet
Z =	3:01	
s =	18%	
n =	0.040	
Depth =	0.43	feet
Velocity =	7	f.p.s.
Basin Length =	250	feet
less Ti distance =	0	feet
Tt distance =	250	feet
Tt distance/Velocity =	36	seconds
=	0.6	minutes
Tc = Ti + Tt =	10.8	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	5.70	inch/hr
Q=∑(CA) * I	**20.2**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **F, G, H, J**
Concentration Point = **4**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	45.9			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	45.9	0.30	13.77	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	13.77	

Calculate Tc
This basin is downstream of concentration points 8, 9 and 10 (basins G,H and J
Concentration point 10 has the longest Tc of 8.7 minutes

Ti =	8.7	min.

Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 40 cfs (1/2 expected flow) for travel time calculation.

Q=	40	c.f.s.
BW =	2	feet
Z =	3:01	
s =	14%	
n =	0.040	
Depth =	0.91	feet
Velocity =	9.4	f.p.s.
Basin Length =	1000	feet
less Ti distance =	0	feet
Tt distance =	1000	feet
Tt distance/Velocity =	106	seconds
=	1.8	minutes
Tc = Ti + Tt =	10.5	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	5.81	inch/hr
Q=∑(CA) * I	**80.1**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **D, E**
Concentration Point = **5**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	10.2			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	10.2	0.30	3.06	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	3.06	

Calculate Tc
This basin is downstream of concentration point 11 (basin E)
Concentration point 11 has the Tc of 6.9 minutes

Ti =	6.9	min.

Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 9 cfs (1/2 expected flow) for travel time calculation.

Q=	9	c.f.s.
BW =	2	feet
Z =	3:01	
s =	13%	
n =	0.040	
Depth =	0.44	feet
Velocity =	6.1	f.p.s.
Basin Length =	1200	feet
less Ti distance =	0	feet
Tt distance =	1200	feet
Tt distance/Velocity =	197	seconds
=	3.3	minutes
Tc = Ti + Tt =	10.2	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	5.92	inch/hr
Q=∑(CA) * I	**18.1**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **J**
Concentration Point = **8**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	6.9			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	6.9	0.30	2.07	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	2.07	

Calculate Tc

Approximate slope for the first 100' of the basin= 31.25 %
D = distance over which Ti develops = 100 feet (Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33 From Figure 3-3)
Ti = 4.6 min.
Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 8 cfs (1/2 expected flow) for travel time calculation.

Q=	8	c.f.s.
BW =	2	feet
Z =	3:01	
s =	35%	
n =	0.040	
Depth =	0.32	feet
Velocity =	8.3	f.p.s.
Basin Length =	1100	feet
less Ti distance =	100	feet
Tt distance =	1000	feet
Tt distance/Velocity =	120	seconds
=	2.0	minutes
Tc = Ti + Tt =	6.6	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	7.84	inch/hr
Q=∑(CA) * I	**16.2**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **H**
Concentration Point = **9**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	18.1			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	18.1	0.30	5.43	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	5.43	

Calculate Tc

Approximate slope for the first 100' of the basin= 25.00 %
D = distance over which Ti develops = 100 feet (Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33 From Figure 3-3)

Ti =	4.9	min.

Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 18 cfs (1/2 expected flow) for travel time calculation.

Q=	18	c.f.s.
BW =	2	feet
Z =	3:01	
s =	44%	
n =	0.040	
Depth =	0.46	feet
Velocity =	11	f.p.s.
Basin Length =	2200	feet
less Ti distance =	100	feet
Tt distance =	2100	feet
Tt distance/Velocity =	191	seconds
=	3.2	minutes
Tc = Ti + Tt =	8.1	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	6.86	inch/hr
Q=∑(CA) * I	**37**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **G**
Concentration Point = **10**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	8.8			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	8.8	0.30	2.64	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	2.64	

Calculate Tc

Approximate slope for the first 100' of the basin= 25.00 %
D = distance over which Ti develops = 100 feet (Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33 From Figure 3-3)
Ti = 4.9 min.
Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 10 cfs (1/2 expected flow) for travel time calculation.

Q=	9	c.f.s.
BW =	2	feet
Z =	3:01	
s =	41%	
n =	0.040	
Depth =	0.33	feet
Velocity =	9.2	f.p.s.
Basin Length =	2200	feet
less Ti distance =	100	feet
Tt distance =	2100	feet
Tt distance/Velocity =	228	seconds
=	3.8	minutes
Tc = Ti + Tt =	8.7	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	6.54	inch/hr
Q=∑(CA) * I	**17.3**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **E**
Concentration Point = **11**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	2.2			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	2.2	0.30	0.66	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	0.66	

Calculate Tc

Approximate slope for the first 100' of the basin= 20.00 %
D = distance over which Ti develops = 100 feet (Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33 From Figure 3-3)
Ti = 5.3 min.
Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 2 cfs (1/2 expected flow) for travel time calculation.

Q=	3	c.f.s.
BW =	1	feet
Z =	3:01	
s =	17%	
n =	0.040	
Depth =	0.3	feet
Velocity =	5.2	f.p.s.
Basin Length =	600	feet
less Ti distance =	100	feet
Tt distance =	500	feet
Tt distance/Velocity =	96	seconds
=	1.6	minutes
Tc = Ti + Tt =	6.9	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	7.60	inch/hr
Q=∑(CA) * I	**5.0**	**c.f.s.**

Hydrology Analysis
After Project Conditions

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Hydrology Calculations

Hydrology Analysis of area(s) = **A, F, G, H, J**
Concentration Point = **1**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Each SFD assumed to convert 5,000 s.f. to 90% impervious.

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	62.4			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	62	0.30	18.60	
Area D soil	0	0.35	0.00	
Area 90% impervious	0.4	0.84	0.34	
Sum C*A		0.31	18.94	

Calculate Tc
This basin is downstream of concentration point 4 (basins F,G,H and J)
Concentration point 4 has the longest Tc of 10.5 minutes

Ti =	10.5	min.

Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 50 cfs (1/2 expected flow) for travel time calculation.

Q=	50	c.f.s.
BW =	2	feet
Z =	3:01	
s =	8%	
n =	0.040	
Depth =	1.14	feet
Velocity =	8	f.p.s.
Basin Length =	1000	feet
less Ti distance =	0	feet
Tt distance =	640	feet
Tt distance/Velocity =	80	seconds
=	1.3	minutes
Tc = Ti + Tt =	11.8	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	5.37	inch/hr
Q=∑(CA) * I	**102**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **B,K**
Concentration Point = **2**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Each SFD assumed to convert 5,000 s.f. to 90% impervious.

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	5.4			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	5.3	0.30	1.59	
Area D soil	0	0.35	0.00	
Area 90% impervious	0.1	0.84	0.05	
Sum C*A		0.31	1.64	

Calculate Tc

Approximate slope for the first 100' of the basin= 21.00 %
D = distance over which Ti develops = 100 feet (Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33 From Figure 3-3)
Ti = 5.2 min.

Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 2 cfs (1/2 expected flow) for travel time calculation.

Q=	6	c.f.s.
BW =	1	feet
Z =	3:01	
s =	16%	
n =	0.040	
Depth =	0.43	feet
Velocity =	6.1	f.p.s.
Basin Length =	1500	feet
less Ti distance =	100	feet
Tt distance =	1400	feet
Tt distance/Velocity =	230	seconds
=	3.8	minutes
Tc = Ti + Tt =	9.0	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	6.42	inch/hr
Q=∑(CA) * I	**10.5**	**c.f.s.**

Hydrology Calculations

Hydrology Analysis of area(s) = **C, D, E**
Concentration Point = **3**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Each SFD assumed to convert 5,000 s.f. to 90% impervious.

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	11.8			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	11.7	0.30	3.51	
Area D soil	0	0.35	0.00	
Area 90% impervious	0.1	0.84	0.05	
Sum C*A		0.30	3.56	

Calculate Tc
This basin is downstream of concentration point 5 (basins D and E)
Concentration point 5 has the Tc of 10.2 minutes

Ti =	10.2	min.

Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 10 cfs (1/2 expected flow) for travel time calculation.

Q=	10	c.f.s.
BW =	2	feet
Z =	3:01	
s =	18%	
n =	0.040	
Depth =	0.43	feet
Velocity =	7	f.p.s.
Basin Length =	250	feet
less Ti distance =	0	feet
Tt distance =	250	feet
Tt distance/Velocity =	36	seconds
=	0.6	minutes
Tc = Ti + Tt =	10.8	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	5.70	inch/hr
Q=∑(CA) * I	**20.3**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **F, G, H, J**
Concentration Point = **4**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Each SFD assumed to convert 5,000 s.f. to 90% impervious.

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	45.9			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	45.5	0.30	13.65	
Area D soil	0	0.35	0.00	
Area 90% impervious	0.4	0.84	0.34	
Sum C*A		0.31	13.99	

Calculate Tc
This basin is downstream of concentration points 8, 9 and 10 (basins G,H and J
Concentration point 10 has the longest Tc of 8.7 minutes

Ti =	8.7	min.

Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 40 cfs (1/2 expected flow) for travel time calculation.

Q=	40	c.f.s.
BW =	2	feet
Z =	3:01	
s =	14%	
n =	0.040	
Depth =	0.91	feet
Velocity =	9.4	f.p.s.
Basin Length =	1000	feet
less Ti distance =	0	feet
Tt distance =	1000	feet
Tt distance/Velocity =	106	seconds
=	1.8	minutes
Tc = Ti + Tt =	10.5	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	5.81	inch/hr
Q=∑(CA) * I	**81.3**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **D, E**
Concentration Point = **5**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Project has no impact on this basin.

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	10.2			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	10.2	0.30	3.06	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	3.06	

Calculate Tc
This basin is downstream of concentration point 11 (basin E)
Concentration point 11 has the Tc of 6.9 minutes

Ti =	6.9	min.

Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 9 cfs (1/2 expected flow) for travel time calculation.

Q=	9	c.f.s.
BW =	2	feet
Z =	3:01	
s =	13%	
n =	0.040	
Depth =	0.44	feet
Velocity =	6.1	f.p.s.
Basin Length =	1200	feet
less Ti distance =	0	feet
Tt distance =	1200	feet
Tt distance/Velocity =	197	seconds
=	3.3	minutes
Tc = Ti + Tt =	10.2	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	5.92	inch/hr
Q=∑(CA) * I	**18.1**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **J**
Concentration Point = **8**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Project has no impact on this basin.

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	6.9			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	6.9	0.30	2.07	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	2.07	

Calculate Tc

Approximate slope for the first 100' of the basin= 31.25 %
D = distance over which Ti develops = 100 feet (Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33 From Figure 3-3)
Ti = 4.6 min.
Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 8 cfs (1/2 expected flow) for travel time calculation.

Q=	8	c.f.s.
BW =	2	feet
Z =	3:01	
s =	35%	
n =	0.040	
Depth =	0.32	feet
Velocity =	8.3	f.p.s.
Basin Length =	1100	feet
less Ti distance =	100	feet
Tt distance =	1000	feet
Tt distance/Velocity =	120	seconds
=	2.0	minutes
Tc = Ti + Tt =	6.6	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	7.84	inch/hr
Q=∑(CA) * I	**16.2**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **H**
Concentration Point = **9**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Project has no impact on this basin.

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	18.1			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	18.1	0.30	5.43	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	5.43	

Calculate Tc

Approximate slope for the first 100' of the basin= 25.00 %
D = distance over which Ti develops = 100 feet (Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33 From Figure 3-3)
Ti = 4.9 min.
Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 18 cfs (1/2 expected flow) for travel time calculation.

Q=	18	c.f.s.
BW =	2	feet
Z =	3:01	
s =	44%	
n =	0.040	
Depth =	0.46	feet
Velocity =	11	f.p.s.
Basin Length =	2200	feet
less Ti distance =	100	feet
Tt distance =	2100	feet
Tt distance/Velocity =	191	seconds
=	3.2	minutes
Tc = Ti + Tt =	8.1	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	6.86	inch/hr
Q=∑(CA) * I	**37**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **G**
Concentration Point = **10**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Each SFD assumed to convert 5,000 s.f. to 90% impervious.

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	8.8			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	8.6	0.30	2.58	
Area D soil	0	0.35	0.00	
Area 90% impervious	0.2	0.84	0.17	
Sum C*A		0.32	2.75	

Calculate Tc

Approximate slope for the first 100' of the basin= 25.00 %
D = distance over which Ti develops = 100 feet (Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33 From Figure 3-3)
Ti = 4.8 min.
Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 10 cfs (1/2 expected flow) for travel time calculation.

Q=	9	c.f.s.
BW =	2	feet
Z =	3:01	
s =	41%	
n =	0.040	
Depth =	0.33	feet
Velocity =	9.2	f.p.s.
Basin Length =	2200	feet
less Ti distance =	100	feet
Tt distance =	2100	feet
Tt distance/Velocity =	228	seconds
=	3.8	minutes
Tc = Ti + Tt =	8.6	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	6.59	inch/hr
Q=∑(CA) * I	**18.1**	**c.f.s.**

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Hydrology Calculations

Hydrology Analysis of area(s) = **E**
Concentration Point = **11**
Land Use Designation = (1 D.U. / 8 acres)
(Use undisturbed natual terrain for this density)

Project has no impact on this basin.

Calculate C*A

	Area	C value	C * A	(C values from Table 3-1)
Total Area (acres)	2.2			
Area A soil	0	0.20	0.00	
Area B soil	0	0.25	0.00	
Area C soil	2.2	0.30	0.66	
Area D soil	0	0.35	0.00	
Sum C*A		0.30	0.66	

Calculate Tc

Approximate slope for the first 100' of the basin= 20.00 %
D = distance over which Ti develops = 100 feet (Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33 From Figure 3-3)
Ti = 5.3 min.
Tt = Travel time in natural channel
Assume a 2' wide bottom with 3:1 side slopes as average shape of the natural channel.
Assume an average flow rate of 2 cfs (1/2 expected flow) for travel time calculation.

Q=	3	c.f.s.
BW =	1	feet
Z =	3:01	
s =	17%	
n =	0.040	
Depth =	0.3	feet
Velocity =	5.2	f.p.s.
Basin Length =	600	feet
less Ti distance =	100	feet
Tt distance =	500	feet
Tt distance/Velocity =	96	seconds
=	1.6	minutes
Tc = Ti + Tt =	6.9	minutes
Selected Frequency =	100	year
6 hr precipitation =	3.0	inch
24 hr precipitation =	7.9	inch
6 hr/24 hr precip =	0.38	<0.45 need to adjust
Adjusted 6 hr =	3.6	inch
I = (7.44*P6)*(D^-0.645) =	7.60	inch/hr
Q=∑(CA) * I	**5.0**	**c.f.s.**

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Summary of Flows before and after project

Point #	Flow before (cfs)	Flow after (cfs)	Change (cfs)
1	101	102	1
2	10.4	10.5	0.1
3	20.2	20.3	0.1
4	80	81	1
5	18.1	18.1	0
6	6.6	6.6	0
8	16.2	16.2	0
9	37	37	0
10	17.3	18.1	0.8
11	5.0	5.0	0

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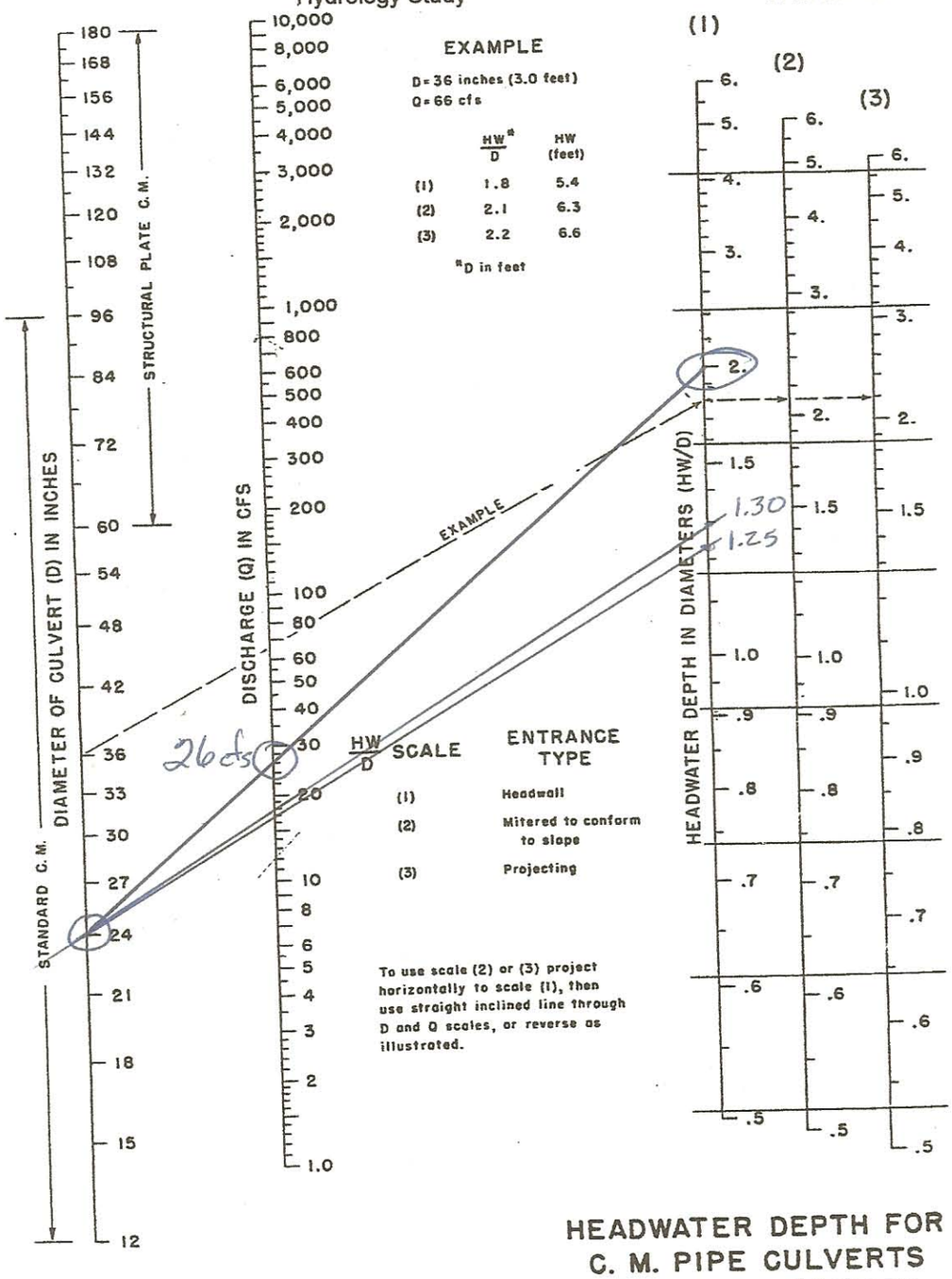
Hydrology Study

TPM 20778



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HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

Culvert Analysis (24" under SR94)

APPENDIX A

Hydraulic Calculations for Lines of Inundation

Hydraulic Calculations for Lines of Inundation

The calculations for the lines of inundation are based on cross-sections taken from the 200 scale topographic map used for the hydrology calculations. The sections were taken every hundred feet with the orientation looking downstream. Flow calculations were based on the Manning's equation for open channel flow. The channel sections being examined are sufficiently long that normal flow should have time to develop. The normal depth should be close enough to the actual flow depth for determination of inundation limits.

Section 1
Q = 102 c.f.s.
Bottom width = 2 feet
Manning's n value = 0.040 (steep rough natural channel)
Side slope left = 2:1
Side slope right = 5:1
Channel slope = 10%
Depth = 1.43 feet
Velocity = 10.1 f.p.s.

Section 2
Q = 102 c.f.s.
Bottom width = 2 feet
Manning's n value = 0.040 (steep rough natural channel)
Side slope left = 1:1
Side slope right = 3.3:1
Channel slope = 13%
Depth = 1.56 feet
Velocity = 12.2 f.p.s.

Section 3
Q = 102 c.f.s.
Bottom width = 2 feet
Manning's n value = 0.040 (steep rough natural channel)
Side slope left = 25:1
Side slope right = 14:1
Channel slope = 10%
Depth = 0.83 feet
Velocity = 6.8 f.p.s.

Section 4
Q = 102 c.f.s.
Bottom width = 2 feet
Manning's n value = 0.040 (steep rough natural channel)
Side slope left = 2:1
Side slope right = 5:1
Channel slope = 11%
Depth = 1.41 feet
Velocity = 10.6 f.p.s.

Section 5
Q = 102 c.f.s.
Bottom width = 2 feet
Manning's n value = 0.040 (steep rough natural channel)
Side slope left = 5:1
Side slope right = 30:1
Channel slope = 6%
Depth = 0.96 feet
Velocity = 5.8 f.p.s.

Section 6
Q = 102 c.f.s.
Bottom width = 2 feet
Manning's n value = 0.040 (steep rough natural channel)
Side slope left = 3.3:1
Side slope right = 50:1
Channel slope = 6%
Depth = 0.83 feet
Velocity = 5.2 f.p.s.

Section 7
Q = 81 c.f.s.
Bottom width = 2 feet
Manning's n value = 0.040 (steep rough natural channel)
Side slope left = 8:1
Side slope right = 20:1
Channel slope = 5%
Depth = 0.97 feet
Velocity = 5.4 f.p.s.

Section 8
Q = 81 c.f.s.
Bottom width = 2 feet
Manning's n value = 0.040 (steep rough natural channel)
Side slope left = 4:1
Side slope right = 5:1
Channel slope = 12%
Depth = 1.16 feet
Velocity = 9.7 f.p.s.

Section 9
Q = 81 c.f.s.
Bottom width = 2 feet
Manning's n value = 0.040 (steep rough natural channel)
Side slope left = 5:1
Side slope right = 3:1
Channel slope = 12%
Depth = 1.20 feet
Velocity = 10.0 f.p.s.

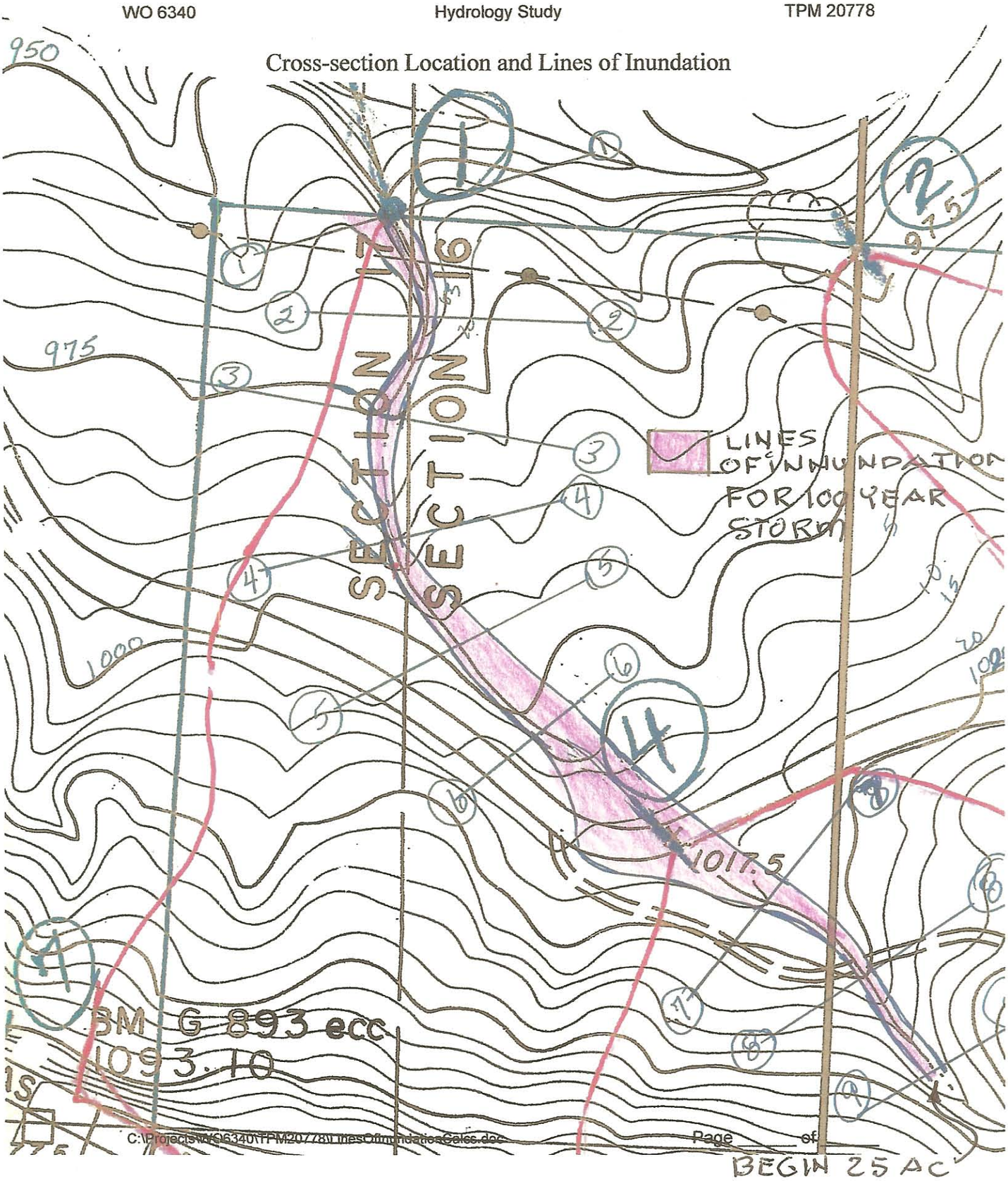
Cross-section Location and Lines of Inundation

5638 Lake Murray Blvd. #216
La Mesa, CA 91942

May Engineering & Surveying, Inc.

Phone (619) 463-8580
Fax (619) 561-3897

Cross-section Location and Lines of Inundation



9880 No. Magnolia Ave. #205
Santee, CA 92071

May Engineering
& Surveying, Inc.

Phone (619) 463-8580
Fax (619) 561-3897

Cross-section Information (looking downstream)

Location		Left		Centerline		Right
Cross-section 1	965 35	960 10	955 6	952 0	955 15	960 27
Cross-section 2		970 15	965 3	962 0	965 10	970 35
Cross-section 3			977 50	975 0	980 70	
Cross-section 4		995 60	990 20	985 0	990 35	
Cross-section 5		1005 60	1000 20	996 0	997 30	
Cross-section 6		1010 30	1005 10	1002 0	1003 50	
Cross-section 7			1025 40	1020 0	1025 100	
Cross-section 8		1035 45	1030 20	1025 0	1030 25	1035 55
Cross-section 9		1045 20	1040 15	1037 0	1040 10	1045 30